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The industrial uses of peat
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PEAT AND ITS INDUSTRIAL APPLICATIONS

WITH SPECIAL REFERENCE TO CANADA

Natural Resources Intelligence Service
Department of the Interior
in co-operation with
The Department of Mines
Ottawa, Canada
1929

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THE INDUSTRIAL USES OF PEAT OTHER THAN FUEL.

With special reference to Canadian
Opportunities particularly in the Manufacture
of Peat Litter and Mull.

Prepared by

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PREFACE

This brief report has been prepared at the request of the Department of Trade and Commerce, in an endeavour to direct attention to the growing demand in Canada and the United States for various peat products, notably peat litter and mull, a demand which is at present almost entirely supplied by importations from Europe. The extensive peat resources of Canada are believed to be capable of development, not only to supply the domestic requirements for these products, but also to yield a material surplus for export to the United States.

The subjects of peat fuel and other fuel products are not dealt with here as they have been fully covered in "The Final Report of the Peat Committee", issued jointly by the Mines Branch, Department of Mines, Ottawa, and the Department of Mines, Toronto, in 1926.

The Natural Resources Intelligence Service gratefully acknowledges the assistance of Mr. A. Anrep, Department of Mines, Mr. M.B. Davis, Department of Agriculture, and Mr. H.W. Cheney, Department of Trade and Commerce, Ottawa, in the preparation of the manuscript.

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PEAT - ITS FORMATION AND CHARACTER

Peat is the general name applied to the combustible remains of plants which have not been subjected to normal decomposition owing to the exclusion of atmospheric oxygen by complete or partial immersion in water. When plants fall on drained soil they are vigorously attacked by micro-organisms and their organic matter disappears in a relatively short time. When plants fall into water, however, decay is slow and a large proportion of their organic matter is retained in the process of carbonization, known as humification. Peat is the result. Most coal was once peat; most coal fields were once swamps and the deposition of peat in swamps and bogs is the first stage in the process of coal formation.

Peat bogs usually occur in shallow depressions having a clay bottom or subsoil and are mainly confined to lowland districts. Glacial action has been an important factor in the origin of many Canadian and American peat bogs. In North America great sheets of ice spread southward over Canada and the northern States from centres of ice accumulation in the Rocky mountains, in the height of land west of Hudson bay, and in Labrador. As these sheets melted back they left deposits of clay, sand, gravel and boulders, formed by the scouring and gouging action of the ice and glacial streams.

These deposits blocked innumerable stream valleys and formed lakes, ponds and marshes in great profusion. Although the ice disappeared many thousands of years ago, a large number of these bodies of standing water have never been drained. Thus the glaciated areas of North America have provided an ideal surface for the growth of peat forming plants.

The most favourable climatic conditions for the formation of peat are abundant rainfall, high humidity and a cool or moderate temperature. These conditions have existed to a great degree in south-eastern Canada and the contiguous northern states with the result that very large deposits of peat are found in these areas.

Peat Forming Plants.

Although peat forming plants embrace a wide variety of species only a comparatively few are important in the formation of peat bogs. These include sphagnum and hypnum mosses, marsh plants, heath plants, grasses, rushes, sedges, ferns, algae, certain marine plants and sometimes trunks, roots and leaves of trees. As one or another of these plants have predominated in the formation of a bog the peat in it is known as sphagnum, hypnum, grass, carex or heather.

Peat Bogs.

Peat deposits may be divided into two general classes, low bogs and high bogs. A third division, sometimes used, is the composite bog which is really a combination of the first two types.

Low bogs, also known as filled basins, are mainly composed of grasses, sedges, reeds and rushes, while the high bogs, sometimes also called creeping bogs, are principally formed from mosses, heath plants and forest residue. In general, low bogs contain a larger admixture of earthy substances and a consequently higher content of ash than the high bogs.

The composition of peat bogs is extremely variable so that scarcely any deposits contain material which is identical in all its physical properties. Even in the same bog, peat of variable types frequently exists, and the upper layer of a bog in many instances may differ materially in its properties from the layers below, owing to different conditions existing at the time of formation.

Properties.

Peat in its natural state usually ranges in color from yellowish brown to jet black. The lighter shades frequently turn dark when subjected to mechanical treatment and exposure to the air. The more humified varieties are practically always dark in color.

The most striking characteristic of peat is its amazing water holding capacity, the usual ratio being 10 percent of solids to 90 percent of water. Numerous attempts have been made to remove this excess moisture by compression or artificial drying, particularly in the treatment of the fuel peats. None of these experiments have proven successful as yet hence it is now generally conceded that drying can best be effected by exposure to sun and wind.

Analysis.

A typical chemical analysis of peat dried at 212° F. showed 57.03 percent carbon, 5.63 percent hydrogen, 29.67 percent oxygen, 2.09 percent nitrogen, and 5.58 percent ash. An average proximate analysis of several Canadian peats showed 28.7 percent fixed carbon, 64.2 percent volatile matter, 7 percent ash, 1.5 percent nitrogen and a calorific value of 9060 B.T.U's per lb.

CANADIAN RESOURCES

Canada is one of the leading countries of the world in reserves of peat lands, possessing an enormous acreage of bogs throughout the country, more especially in those sectors having a moist cool climate. Other countries with large reserves of peat are, Russia with 65,000 square miles, and Finland with 38,000 square miles. The total area of peat bogs in U.S.A. is said to be about 11,200 square miles and that of Ireland, famed for its peat fuel, is approximately 4,700 square miles.

In considering the possibility of utilizing Canada's vast reserves of peat it must be remembered that a large acreage situated in districts far removed from transportation and markets must be eliminated from present consideration. Further large areas are for economic reasons not suitable for commercial exploitation. Apart from these, however, there remain within the range of economic development, extensive deposits of peat capable of producing good quality litter products. Again there are other peat bogs which are more suitable for reforestration purposes or for the cultivation of agricultural products.

Surveyed Bogs.

In order to secure accurate information on these reserves of peat the Federal Department of Mines, in 1908, began a systematic examination of the more accessible bogs throughout the Dominion. Since that date one hundred and forty-six bogs totalling nearly 285,000 acres have been surveyed, mapped and drilled, and their contents roughly estimated.

A summary of the principal litter bogs investigated follows:-

SURVEYED PEAT LITTER BOGS IN CANADA

Name of Bog	Approx. area.	Estimated possible production of litter with 20% moisture	County or district
	Acres	Tons	
	PRINCE EDWARD ISLAND		
1. Portage *	775	184,000	Prince
2. Miscouche *	2,900	137,000	"
3. Black Banks	885	839,000	"
TOTAL	4,560 acres	1,160,000 Tons	
	NOVA SCOTIA		
1. Caribou *	890	436,000	Kings
2. Heath *	2,175	104,000	"
3. Andrew Island (5 bogs)	245	(25% moisture) 95,000	Guysborough
4, Glasgow Head	65	42,000	"
5. Canso	290	90,000	"
6. Yellow Marsh	30	15,000	"
7. Gasperau	80	54,000	"
8. Sherwink	30	15,000	"
9. Dobson	35	19,000	"
10. Fox Island) Lily Pond) (3 bogs)	85	26,000	"
11. Reynolds	135	41,000	"
12. Indian Head (5 bogs)	830	327,000	"
13. Chimney Rock	310	225,000	"
14. Griffin	65	32,000	"
15. Ocean Lake	155	73,000	"
16. Hay	75	28,000	"
17. Mulgrave	325	194,000	"
18. Seal Harbour	65	23,000	"
19. Meadow	175	83,000	"
20. Isaac Harbour (2 bogs)	455	201,000	"
TOTAL	6,515 acres	2,123,000 tons	

* Also contains considerable humified peat.

Name of Bog	Approx. area.	Estimated possible production of litter with 20% moisture	County or district.
	Acres	Tons	
	NEW BRUNSWICK		
1. Seeley Cove *	125	84,000	Charlotte
2. Pennfield	70	20,000	"
3. Pocolagan *	350	139,000	"
4. Musquash	290	204,000	St. John
5. St.Stephen *	155	135,000	Charlotte
6. Canaan	880	540,000	Westmorland
7. Canaan "B"	105	62,000	"
8. Hick's	250	210,000	"
9. Gades	825	737,000	"
10. Cudmore	350	134,000	"
11. Escuminac	2,675	3,116,000	Northumberland and Kent
12. Eel	17,460	21,011,000	" "
13. Shippigan	11,870	1,500,000	Gloucester
14. Pokemouche	650	528,000	"
15. Shippigan Island (Lamek)	3,840	4,103,000	"
16. Burnt Church	825	846,000	Northumberland
17. Neguac	3,070	4,685,000	"
18. Black Point	500	427,000	"
19. Portage	655	641,000	"
20. Tracadie Beach	245	124,000	Gloucester
21. Boullou Point	205	170,000	"
22. Little Tracadie	240	236,000	"
23. Gasperau	690	576,000	"
24. Green Point	1,515	1,663,000	"
TOTAL	37,840 acres	41,891,000 tons	
	QUEBEC		
1. Riviere de Loup *	7,220	1,928,000	Temiscouata
2. Cacouna	845	626,000	"
3. St.Denis	315	388,000	Kamouraska
4. Riviere Ouelle *	4,520	2,624,000	"
5. St.Arsene *	2,160	856,000	Temiscouata
6. St.Anaclet *	3,250	278,000	Rimouski
TOTAL	18,310 acres	6,700,000 tons.	

* Also contains considerable humified peat.

Name of Bog	Approx. area	Estimated possible production of litter with 20% moisture	County or district
	Acres	Tons	
		ONTARIO	
1. Crozier	355	518,000	Rainy River
		MANITOBA	
1. Litter	110	104,000	Tp.15,R.14,E.
2. Julius	3,900	2,449,000	Tp.11-12,R.10 (E.Prin.Mer.)
TOTAL	4,010 acres	2,553,000	
		BRITISH COLUMBIA	
1. Burnt Road	700	466,000	Burnaby
2. Smaller Lulu Island	1,700	823,000	Richmond
3. Delta	4,700	3,412,000	Delta
4. Pacific Highway	25	16,000	S.Westminster
TOTAL	7,125 acres	4,717,000 tons.	

SUMMARY

Province	Number of Bogs	Area in Acres	Estimated possible production of peat litter in Tons.
Prince Edward Island	3	4,560	1,160,000
Nova Scotia	20	6,515	2,123,000
New Brunswick	24	37,840	441,891,000
Quebec	6	18,310	6,700,000
Ontario	1	355	518,000
Manitoba	2	4,010	2,553,000
British Columbia	4	7,125	4,717,000
TOTAL	60	78,715 acres	59,662,000 tons.

PEAT LITTER AND MULL (*)

Peat may be roughly divided into two classes, fuel peat and litter peat. The fuel peat is highly humified and has in large measure lost its fibrous form. Litter peat, on the other hand, is very little humified and has retained its fibrous structure.

The manufacture of this loose fibrous material into litter and mull is an old established industry in Europe and its production there has reached a high state of efficiency. Very little peat litter has been made in North America, however, requirements being largely supplied by imports from Germany, Holland, Belgium and Sweden.

MANUFACTURE

The successive steps usually employed in the production of peat litter and mull are as follows:-

Selection of a suitable deposit

A bog of ample proportions containing a large tonnage of moss peat which has undergone very little humification is essential.

Drainage

In order to present a firm working surface and to facilitate drying operations, a bog is usually chosen which is easy to drain. If the entire bog is drained at one time, the moss is liable to humify rapidly and turn dark, hence the usual procedure is to drain only that portion of the bog actually being worked.

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* Detailed information on manufacturing processes, machinery requirements, cost of production, etc., may be obtained from the Department of Mines, Ottawa.

Excavation of Raw Peat

The peat is usually dug by hand in blocks about six inches thick and placed on a high section of the bog to dry. In Europe hand digging has been found, in most instances, more economical than mechanical excavation. In Canada, however, the higher labour costs may turn the balance in favor of digging by machinery.

Drying

The peat blocks are dried by exposure to sun and wind, drying being greatly facilitated if the blocks are subjected to the disintegrating action of frost during the winter. The blocks are usually turned once to expose the under surface. In localities where a good deal of rain falls the blocks are sometimes placed in open sheds or stacks to dry.

Harvesting

When dried to about 20 per cent moisture, the blocks are gathered and either stored under cover or taken directly to the disintegrators.

Disintegration

The dried peat blocks are fed through shredders which tear the fibres apart. The litter is then screened to remove fines (peat mull) and sent to the balers. Three kinds of litter are commonly produced, a coarse variety designed for use as a stable litter, a finer grade used as a litter for poultry and small animals, and the third and finest variety--peat mull. The shredding machines are adjusted to produce the variety desired. If more mull is required than that produced by the ordinary disintegrator, a fine shredder is used yielding mull as the main product.

Preparation for the Market

Both litter and mull are marketed in pressed bales bound with wooden slats and wire. For export the bales are covered with burlap. The weight of a bale of litter varies according to size and moisture content, the common weight being about 150 to 160 pounds. Bales of mull are usually about 20 pounds heavier.

Small Scale Operations

An easy method of making peat litter is often used by farmers. A section of the bog is drained and ploughed to a depth of 6 or 7 inches in the fall. The ensuing spring the ploughed surface is thoroughly cultivated and harvested when sufficiently dry.

USES OF LITTER AND MULL

Stable Litter

Peat litter, on account of its exceptional absorbent and deodorant qualities, is a splendid stable litter for horses, cattle and pigs. It is springy and durable and tends to keep animals' hoofs in good shape. Due to its power of absorbing and holding large quantities of moisture (it will absorb from 5 to 15 times as much liquid as straw) it does not require as frequent changing as other litters and keeps the stock in better condition. Not only does it conserve that most valuable portion of manure--the liquids, which contain over half the nitrogen and four-fifths of the potash,--but it is an important factor in keeping down objectionable ordors. This latter property is of special value in dairy barns where milk is easily tainted by odors.

Peat litter is widely used in Europe as a bedding for mine animals which are kept underground. It does not ignite easily and lasts much longer than other litters. One ton of peat litter is said to last as long as 2½ tons of straw.

Poultry Litter

The finer varieties of peat litter, including mull, are being extensively used on poultry ranches. When used as a bedding in the pens it obviates the need of daily cleaning and absorbs the valuable volatile elements of the droppings to form a valuable manure. When scattered lightly in the chicken runs it provides an ideal scratching material. Due to its antiseptic qualities it acts as an insecticide and is an important aid in preventing poultry diseases.

Fine peat litter and mull are often advantageously used as bedding material for small animals such as dogs, rabbits and guinea pigs.

Packing Material

Peat mull and other finely divided fibrous peat products, because of their remarkable power of destroying bacteria and preventing decomposition as well as their spongy resilent nature, provide an ideal packing medium for perishable products such as meat, eggs, fish, fresh fruit and vegetables. They are also excellent for packing fragile articles.

Hard fruits such as apples, boxed in peat mull retain their fresh appearance for months with very little withering or decay; the same may be said of plant and flower bulbs, potatoes and onions, which moreover do not sprout prematurely. An experimental shipment of fish, packed in peat, was found to be in perfect condition after an 18-day journey.

On account of their excellent heat insulating qualities the fibrous peats provide protection against frost in the shipping of fresh fruit, vegetables, flowers, shrubs and plants long distances in cold weather, or to cold countries.

Best results in packing perishable materials are obtained by utilizing a peat mull containing less than 30 per cent moisture, the packing being conducted in a room in which the humidity and temperature are kept low.

Stock Food

Peat is frequently used both in Europe and the United States as a base for the preparation of various commercial stock foods, particularly those compounded with the uncrystallized residues of beet and sugar cane refineries. Molasses, although a valuable foodstuff, requires an effective diluent owing to its viscous liquid condition and its extreme laxative action when concentrated.

Peat not only coverts the crude molasses into a convenient and stable product and largely obviates the danger of digestive disturbances, but it also adds a small amount of proteid substance and improves the palatability of the food. It is claimed that as high as 50 per cent of molasses may be used in a stock food when mixed with peat.

The corrective qualities of peat make it a desirable material also for admixture with cotton seed meal.

Peat mull and specially prepared peat powder are most frequently used in stock foods, although fine peat litter is sometimes also employed. In the manufacture of peat powder for this purpose, the surface of the bog to be utilized is ploughed, disked and harrowed and the peat excavated to a depth of about three feet and left in windrows. It is then air-dried, harvested and run through heated rotary driers until the moisture is reduced to about 10 per cent and the peat partly carbonized. The resultant product is then ground and screened.

Sanitation

The absorbent and deodorant qualities of peat mull render it a very desirable material for use in earth closets, cess pools and for sanitary purposes in all localities where hydraulic sewage disposal facilities are not available. In many small European villages and towns the use of peat or some similar material for this purpose is enforced by the health authorities.

Horticulture

The use of peat mull and humus in the propagation of plants and flowers is dealth with on page 20 under the heading of "Soil Conditions".

PEAT LITTER INDUSTRY IN EUROPE

Mr. A. Anrep, Peat Specialist of the Department of Mines, Ottawa, in the Summary Report of the Geological Survey, 1927, Part A, comments on the peat litter industry in Europe as follows:-

> "The manufacture of peat litter and peat mull is an important industry in various northern European countries. Precise statistical information regarding annual output is not available, but an idea of the extent of the industry is afforded by the following statements. Belgium produces peat litter and peat mull for local use and for export. Finland, in 1926 manufactured 465,000 bales, each of about 120 pounds weight, of peat litter and mull. Germany in the same year produced 235,000 tons of baled peat litter and peat mull, as well as large quantities consumed locally. Holland, it is estimated, manufactures about 200,000 tons annually and a large amount of this is exported. In Norway the annual production is about 500,000 bales each weighing 160 to 180 pounds. Sweden, in 1926, produced about

228,000 tons. Russia, in 1926 manufactured only about 7,000 tons of peat litter and peat mull, but it is estimated that farmers for their own use produced about 820,000 tons."

Mr. J.C. Macgillivray, Canadian Trade Commissioner, writing from Rotterdam, gives the following description of the peat litter and mull industry in Holland:-

"Instead of being used as fuel, the upper layers of the peat bogs are often ground up into litter and dust. The former is used for horses, cattle and poultry, and the latter as a fertilizer and for packing fruit. The only difference between the several products is that they are sifted to the degree necessary to suit the particular purpose.

The manufacturing is done entirely by machinery imported from Germany. This grinds up the peat and separates it into moss, litter, or dust, after which, in the case of the former two, it is pressed into bales weighing 100, 90, or 80 kilos, depending on the requirements of the purchaser.

A 100-kilo bale of peat costs from 80 cents to $1.00, while a 50-kilo bale can be purchased for 50 cents.

Exports of peat moss and peat litter totalled 65,394 metric tons valued at $336,393 during 1927. In the same year, 5,730 metric tons with a value of $22,195 were imported from Germany.

The Dutch exports in detail for that period were as follows:-

Germany	5,473 tons
Belgium	16,504
United Kingdom	14,719
France	4,396
United States	4,692
Spain	1,137
Switzerland	15,980
British East Africa	584
British West Africa	270
Czechoslovakia	871
Luxemburg	90
South Africa	581

For the first six months of 1928 the exports of the same materials show a tendency to increase, having risen from 37,793 tons during the corresponding period in 1927 to 51,491 tons in 1928. The countries of destination remains the same."

CANADIAN RESERVES OF LITTER PEAT

Canada is particularly fortunate in having at various strategic points in the Dominion large peat areas suitable for the production of litter in quantity. In the Maritimes, in Quebec and in British Columbia are found extensive peat bogs capable of yielding high grade litter equal to or better in quality than the imported product.

New Brunswick is the leading Canadian province in reserves of litter peat. At the 27 surveyed bogs in that province 24 are litter bogs containing an aggregate of about 70 per cent of the total Dominion reserves. The 12 largest New Brunswick bogs have been estimated to contain 39,235,000 tons of litter. The greatest of these is the Eel bog covering 17,000 acres and containing in excess of 21 million tons of litter.

Quebec ranks second in known reserves of peat litter, having five large bogs containing over 6 million tons of litter. The two outstanding deposits are the Riviere Ouelle bog in the Kamouraska district with over 2½ million tons of litter and the Riviere du Loup bog containing nearly 2 million tons.

There are three litter bogs in British Columbia said to possess commercial possibilities, all of them situated on the Fraser river delta. The calculated tonnage in these bogs is nearly 5,000,000 tons. The largest bog, the Delta, is estimated to contain about 3,500,000 tons of recoverable litter.

The peat bogs of Nova Scotia are rather small, and may not be found to be large enough for the commercial production of litter on a large scale. Several of them, however, contain an excellent grade of litter and are capable of development on a small scale to supply local requirements. In this category may also be included numerous small bogs in New Brunswick and Prince Edward Island.

CANADIAN DEVELOPMENTS

Peat litter has not yet been produced on a commercial scale in Canada, although an appreciable output is expected soon from two plants, one in eastern Canada and the other in the far west. Mr. Anrep stated in the mining news letter issued by the Department of Mines on August 22, 1929, that "At present two small plants for the manufacture of peat litter and mull are under construction in Canada. One of them is situated on a 150-acre bog a few miles from St.Stephen N.B., and the other on a 100-acre bog near New Westminster, B.C. It is expected that both of these plants will have litter and mull ready for the Canadian market this autumn."

POTENTIAL MARKETS

Canada

While the present consumption of peat litter and mull in Canada is comparatively small, the demand is steadily growing, owing to the increasing popularity of the coarse litter as a bedding for poultry and animals, and of the finer varieties for packing fragile articles, fruits and seedlings and for horticultural purposes.

In this connection it is interesting to note that in 1926 several of the large poultry ranchers in the vicinity of Vancouver, finding difficulty in maintaining fowl in a sanitary condition by the use of straw, imported a quantity of peat litter from Europe to use in the pens and on the scratching ground. The litter was found to be a great improvement; the chickens were cleaner and brighter, scratched more vigorously, and laid more eggs.

This experiment has already resulted in a greatly augmented market for litter on the Pacific coast. Mr. Anrep reported that -- "During the period March 1926 to February 1927, 677 tons

> were imported from Belgium, Germany and Holland. Of this amount, 589 tons were brought in through the port of Vancouver and delivered to the owners of chicken ranches in the vicinity of New Westminster, at a cost to the consumers which varied from $40 to $60 per tons."

Detailed statistics of the present importations of litter into Canada have not yet been prepared, but it is believed that the present consumption is between 1,500 and 2,000 tons. The two main ports of entry are Vancouver and Montreal. The retail price of litter in Eastern Canada probably averages around $50 per ton.

The domestic market is undoubtedly still capable of material expansion, particularly if the manufacturers find it possible to market litter at a lower rate than that charged for the imported product.

United States

One of the most promising factors in the establishment of plants for the production of peat litter in Canada, even greater than the exploitation of home markets, is the possibility of building up a profitable export business with U.S.A.

There is at present no commercial production of peat litter in U.S.A., and according to a bulletin dated 19th November, 1928, issued by the Chemical Division of the Bureau of Foreign and Domestic Commerce, Washington,-

"Imports of peat moss into the United States have been increasing steadily in recent years and it may be said that there has been a consistent increase of almost 100 per cent each year for the last four years. Imports of this commodity rose from 4,947 tons in 1924 to 9,137 tons in 1925. The year 1925 saw a further increase to 14,883 tons, and a peak was reached in 1927 when 28,210 tons were imported. Of the 1927 imports, approximately 21,500 tons were furnished by Germany, 4,500 tons by the Netherlands, and smaller amounts by Bulgaria, Sweden and Belgium."

UNITED STATES IMPORTS

The following table shows the tonnage and value of peat importations into U.S.A. These imports were almost entirely litter and mull:-

Year	Tons	Value $	Value per ton $
1915	7,514	48,142	6.41
1920	2,762	36,201	13.11
1921	3,450	22,754	6.30
1922	4,805	33,034	6.87
1923	5,973	43,184	7.23
1924	4,947	65,853	13.31
1925	9,137	121,719	13.32
1926	14,883	174,241	11.71
1927	28,210	326,549	11.58

United States importers are interested in securing supplies of peat litter in Canada as evidenced by the fact that several inquiries for supplies of Canadian peat litter have been received by the Department of Mines and the Department of Trade and Commerce, one New York importer asking for quotations on 250,000 bales. Another inquirer stated that he was in the market for several carloads of peat moss per month.

Location of Main United States Markets

The following table shows the 1927 imports of peat moss into the United States by customs districts:-

Customs District	Tons
New York	15,669
Philadelphia	3,319
Massachusetts	2,820
Washington	1,870
Maryland	1,573
San Francisco	745
Los Angeles	403
Maine and New Hampshire	395
Oregon	381
Florida	251
New Orleans	244
Virginia	236
Georgia	152
All others	152

This table demonstrates that there is a good distribution of litter in Pacific coast states, not far removed from the litter deposits of British Columbia and a still larger market in the east, within transportation distance of the New Brunswick and Quebec litter bogs.

FERTILIZERS

While a good deal of confusion has arisen from time to time regarding the value of peat as a fertilizer the concensus of opinion at present seems to be that in its natural condition peat is seldom satisfactory for use as a complete fertilizer. Alfred P. Dachnowski of the Office of Soil Bacteriology, United States Department of Agriculture, an authority on fertilizers, has stated that "Without any preparation whatever raw peat is inferior in its effect to stable manure".

It is well known that peat contains a large percentage of organic matter, including considerable nitrogen. However, until the acidity of the peat has been corrected by exposure to sun and wind for a considerable period it is not in a condition favourable to the life of bacterial organisms which aid fertility and the nitrogen contained is largely in a form not available to plants.

Various preparatory methods of improving the fertilizing qualities of peat have been employed, some of which have undoubtedly been successful experimentally, but unfortunately, none of these products have yet been able to compete in cost with the usual commercial fertilizers.

The main uses of peat as a fertilizer material are therefore, as a soil conditioner, as a filler in commercial fertilizers, and as a base for composting manures. The use of peat in the development of fertilizing bacteria is also worthy of mention.

SOIL CONDITIONER

Except for use in the cultivation of orchids, rhododendrons, blueberries and other plants that require an acid soil and are capable of using nitrogen in organic form, raw peat is not a good fertilizer material. If used in sufficient quantities, however, it imparts desirable characteristics to certain types of soil rendering them more productive. For this purpose it is usually known as a soil conditioner.

Dry caked soils and those inclined to be cold or leachy are benefitted by the admixture of peat. It also helps to bind together and to give more body to loose sandy soils and to break up and render more friable heavy clay soils. In general peat lightens the soil and promotes aeration, increases the capacity of the soil to absorb and retain moisture and improves the absorption of the sun's rays.

The most suitable peat for use as a soil conditioner would appear to be the lightly humified variety, preferably slightly acid or neutral in character. This type of peat usually contains greater fertilizing value than the litter peat and still retains most of its enormous capacity for holding water. One of the large U.S. plants marketing a soil conditioner uses a neutral peat of this character.

Peat specially prepared for soil conditioning is frequently known as humus. One well known process used to prepare humus is as follows: The bog is first drained and the surface layer removed, to eliminate sticks, roots and roughage. The exposed peat is harrowed or disked thoroughly and left to dry by the sun and wind. It is then collected and passed through a shredder which tears the peat into small particles. The disintegrated product is screened and stored in large piles out of doors to await shipment.

At some plants which produce fertilizer filler as well as humus the air drying is supplemented by artificial heating but great care is taken that the peat is not carbonized by excessive temperature. Maceration or grinding is usually not recommended as the destruction of the minute air cells in the peat is liable to unfavourably affect the moisture retaining capacity of the product.

Peat soil conditioner is largely used to improve refractory soils. It is used either alone or mixed with sand and leaf mould as a dressing for lawns, golf courses, and bowling greens. It also finds extensive utilization in the propagation of plants, shrubs, and flowers.

Peat humus and mull are valuable for greenhouse use. They are ideal materials for promoting root growth and are much utilized for starting early vegetables and potted plants.

In Canada a small tonnage of humus has been produced in recent years, at Alfred, Ontario, as a by-product of the peat fuel operations. The unharvested fuel is left on the ground through the winter where it is subject to frost action, air dried in the early summer before harvesting, passed through a shredder, screened and shipped. It has been used mainly as a conditioner for lawns and golf courses.

The establishment of a plant of commercial size in Canada as a separate industry for the production of a peat soil conditioner would hardly seem warranted at the present time owing to the limited market for such a product. The production of humus from a suitable peat might easily prove a profitable side line at a plant manufacturing peat fuel or litter however.

FERTILIZER FILLER

The usual constituents of commercial fertilizers, nitrogen, phosphoric acid and potassium must be employed in a form which plants can assimilate and must be used in quantities which will not burn the plant growth. A suitable diluent is therefore essential. Among the various substances which have been used experimentally for this purpose, fibrous absorbent peat has been found to be one of the best. Not only does its use ensure uniformity of color in the finished product but owing to the great amount of moisture absorbed it overcomes the tendency to cake and facilitates the bagging of the fertilizer.

Many of the substances commonly used as fillers have little or no value as plant food, and some contain material that is actually deleterious to plant growth. Peat, on the other hand is rich in humus and supplies additional nitrogen, as well as organic matter to the soil. Although these are, to a great extent, not immediately available as a source of plant food or nourishment for soil organisms, they gradually become so under the conditions formed in cultivated soil. Hence peat derived from an area which has been for some time under cultivation is preferable to raw peat for use in fertilizers.

The use of a peat filler in commercial fertilizers also facilitates the use of many materials which are otherwise difficult to handle. Many kinds of waste matter from packing houses absorb moisture readily from the air, and either cake into hard masses or give off offensive odours.

Peat prevents decomposition to a great degree and absorbs any gases which are released.

Tankage to which about 40% peat has been added gives a uniform product of excellent mechanical condition and rich in ammonia.

Garbage tankage is a low grade of fertilizer material not only on account of its low ammonia content, but also on account of its peculiar mechanical condition. The addition of peat to the tankage as it enters the driers results in a greatly improved product, and the offensive odours incident to garbage reduction are also largely eliminated.

The use of peat in the preparation of fertilizer from fish waste improves the physical condition of the material, prevents disagreeable odours, and reduces the danger of fire. Fish scrap contains a considerable amount of oil, the presence of which leads to heating and danger of fire from spontaneous combustion. When peat is added the oil is largely absorbed by it, and held in such manner as to greatly reduce the danger of heating. The offensive odour of the product is also greatly reduced, and fish scrap when mixed with peat can be more readily mechanically mixed with other fertilizer materials.

PEAT COMPOSTS

Peat is undoubtedly superior to straw as a composting material for manures. It is most frequently used for mixing with stable manure, although composts with fish scrap, sewage and tankage are also well known. Other suggested materials suitable for composting with peat are sugar factory waste, lime sludge from sulphate pulp mills, frosted crops and deteriorated foods.

In addition to conserving the volatile and liquid fertilizing materials which would otherwise be lost, peat adds considerable nitrogen to the product. By composting, nitration is apparently accelerated and the insoluble nitrogen compounds are more rapidly made available for plant use. Professor Robinson of the Michigan Agricultural College stated that the value of farmyard manure is practically doubled by composting with one-third its weight of peat containing 2 per cent nitrogen.

In composting with stable manure the usual practice is to place alternate layers of loose fibrous air dried peat and manure in a composting pit or out-of-doors on a layer of weathered peat several inches in thickness. The piling is continued until a heap 3 to 4 ft. high is built up. The pile is forked over and well mixed from time to time.

The proportions of manure and peat should be varied according to the qualities of the manure and peat used. Experience is the best guide in determining the most desirable mixture. The heap may be 6 to 8 ft. wide and should be located in a shady, cool, well ventilated place. Composts with coarse fibrous peat should remain in a compact pile out-of-doors for six months or longer and should be shovelled over at least twice. If excessive heating occurs the pile should be turned over and more peat added.

Composts with sewage, fish scrap, sugar factory waste, etc., are prepared in much the same manner as with stable manure.

BACTERIZED PEAT

Organic matter, whether of animal or vegetable origin, when mixed with soil undergoes decay, some portions rapidly, others more slowly. This decayed material provides food and energy for numerous soil bacteria and is gradually converted by them into plant food. Bacterial agencies not only produce nitrates and other food

substances but they also aid in rendering available for plants the mineral food constituents of the soil.

In the past few years extensive research work has been carried out both in United States and England to ascertain just what parts are played by different varieties of bacteria found in the soil in transforming insoluble substances into plant food.

Among these micro-organisms the nitrogen-fixing types are probably the most important for they are capable of assimilating free nitrogen and thus add to the soil an increasing store of this necessary element in soluble form. This fact suggested to investigators the possibility of increasing the fertility of soils by impregnating them with nitrifying bacteria. These organisms were easily isolated but the problem was to find a suitable medium whereby they could be safely propogated and placed in the soil.

Among the many substances tried for this purpose peat was found to be an ideal carrier and energizer for several forms of nitrogen-forming bacteria. Subsequent research was therefore directed along the lines of producing a bacterized peat. This was successful and the product gave excellent results but so far has not been able to compete in price with the commercial fertilizers commonly employed in general agriculture. It is quite possible, however, that further investigations may develop a cheaper method of producing this promising material.

AGRICULTURAL LANDS (1)

It is sometimes possible to reclaim peat lands for agricultural purposes by judicious draining and special soil treatment. In many of the Continental countries - Germany, Sweden, Austria, Russia and Finland - large areas of worthless peat bogs have been converted into productive lands by this means.

Nearly 1,000,000 acres of heath and marsh covered land have been drained, cleared and made productive in Denmark. Peat fuel has been removed from huge areas of bog in Holland and the subsoil reclaimed for agriculture. A large acreage of fen and bog land in England has also been turned into good agricultural land. Much waste peat land in the United States has been drained and placed under cultivation, even the Dismal Swamp in the Carolinas and the Everglades of Florida having been made to yield tillable land.

In Canada large areas of excellent arable land are still available, hence the systematic reclamation of bog lands has not yet received much attention. A few bogs in the Maritimes are being utilized for the cultivation of fruit such as the cranberry and shallow peat lands along the margins of many bogs in various parts of Canada are gradually being brought under cultivation.

Undoubtedly there are in the more densely settled parts of Canada many peat bogs, unsuitable for the production of fuel or litter, which could be advantageously reclaimed for truck gardening, for pasture land, for the raising of hay or for the cultivation of cranberries, blueberries or peppermint.

(1) - The preparation of peat lands for agriculture on a large scale is a highly specialized undertaking requiring expert advice. The following section merely deals in a general way with some of the salient features. For further information on the subject and more particularly on the cultivation of the acid tolerant fruits, write the Department of Agriculture, Ottawa.

Preliminary Investigations

Peat soils vary materially in their physical and chemical properties and in their suitability for the growing of crops. Therefore before any considerable expense is incurred in an attempt to reclaim peat lands for agricultural purposes a careful study of the character of the area should be made, and a survey carried out to determine whether the bog can be easily cleared of trees and shrubs and drained. Many peat bogs which are otherwise suitable for agricultural purposes cannot be economically drained or cleared.

If possible a sample plot should be cleared and drained, lime and fertilizers added as required and test crops planted. Surveys and soil examinations being favourable, a thorough study of all available literature on the subject should be made and the most efficient and up-to-date methods of treating similar soils in other countries determined. Such a study will also throw considerable light on the crops best suited to the particular soil in question.

Drainage

A proper drainage system is essential to the successful cultivation of peat lands. The water must be lowered sufficiently to produce a firm working surface for horses and machinery but not low enough to endanger crops by drought. In large drainage areas provision is sometimes made whereby the latter contingency may be avoided by raising the water level during dry weather.

Owing to the great capacity of peat for retaining water the main channels of the drainage system are usually supplemented by a large number of shallow cross drains to remove the surface water.

Fertilizer Requirements

The problem of the fertilization of peat lands is by no means simple and the requirements of any particular deposit should be ascertained by soil analyses supplemented by the records of experience in the cultivation of similar soils elsewhere. The establishment of sample plots on various parts of the bog is also a great aid in determining the proper fertilizer requirements.

Peat soils in general are usually characterized by a high organic content with a plentiful supply of nitrogen and a lack of mineral constituents such as potash and phosphates. They frequently also require the addition of lime to reduce the acidity.

Peat soils which are shallow enough, after settling, for deep ploughing to reach the subsoil will require the addition of much less mineral fertilizer than the deeper soils which must depend entirely on artificial fertilizers (mainly potash and in some cases phosphates) for their supply of lacking plant food. As a reclamation measure light applications of stable manure are usually recommended to provide the fungi and bacteria which cause decay and hasten humus formation.

Frosts

Due to the fact that peat lands are usually in low lying areas and that the black porous soil gives up its heat very rapidly after sundown peat lands are particularly susceptible to summer frosts.

Rolling the surface with a heavy roller exerting at least 1,600 lbs. pressure per yard of length is one efficacious method of reducing the frost menace. This treatment not only compacts the soil but it also provides better support for the plant roots, helps to eliminate wild grasses and shrubs and is an aid in withstanding droughts. Covering the peat with sand, clay or loam also greatly reduces the danger of frost but it adds materially to the cost of the undertaking.

Suitable Crops

Peat soils are usually suitable for truck gardening, particularly in the cultivation of such hardy vegetables as lettuce, celery and onions. Cabbage, spinach, carrots, beets, turnips and cauliflower also thrive on peat land. In localities where summer frosts are not too severe, potatoes can be successfully grown, particularly if plenty of fertilizer is supplied.

Peat soils are well adapted to the growing of hay and also make good pasture land. Other crops which have flourished on reclaimed peat lands include sugar beets, peppermint and flowers such as rhodendrons and orchids.

The acidity of many peat soils render them especially valuable for the raising of cranberries and blueberries.

ACID TOLERANT FRUITS

CRANBERRIES

The cranberry is a popular fruit in Canada, and has for many years commanded a uniformly good price. It is therefore rather astonishing to note that the production of cranberries in Canada is still far from sufficient to supply domestic requirements.

The bulk of the consumption is supplied by imports from United States, which totalled 19,899 barrels valued at $221,260 in 1928 and 21,689 barrels worth $241,371 in fiscal year ending March 31st, 1929. This supply was mainly obtained from the Cape Cod bogs of Massachusetts.

In the United States the cultivation of cranberries on peat land is flourishing. During 1926 the United States Department of Agriculture estimated that 28,000 acres were harvested yielding 744,000 barrels of cranberries, valued at $5,623,000. In 1927 the estimates intimated that 28,000 acres were gathered yielding 495,000 barrels, valued at $6,077,000, The average yield over the period 1920-7 was 20.5 barrels per acre and the average value was $10.88 per barrel. The principal producing states were Massachusetts, New Jersey and Wisconsin.

The operation of cultivated cranberry plantations in Canada has not yet reached large proportions. Nova Scotia leads with producing bogs near Aylesford and Bridgewater. A small output is also made from a few bogs in various stages of cultivation in Prince Edward Island, Quebec and British Columbia and the balance of the Canadian crop is harvested from wild cranberry swamps.

From present indications there seems to be a splendid opportunity for the expansion of this industry. There are numerous localities in Canada suitable for the establishment of further cranberry fields on peat bogs. There appears to be a ready market for over 20,000 barrels of cranberries annually and domestic producers are protected by a general tariff of 25 per cent ad valorem on cranberries.

The principal requirements for the successful cultivation of cranberries are:

An acid peat soil

Good drainage. It should be possible to drain the bog to a depth of 18 inches.

A constant and ample water supply. Water is required for irrigation during droughts and for flooding to protect the plants against winter injury, untimely frosts and injurious insects. Cranberries are sometimes grown on high bogs which are not flooded in the winter, but the low bogs are more prevalent.

An adequate supply of sand near at hand. Most cranberry bogs are covered with a layer of clean coarse sand 3 inches thick.

Easily accessible transportation facilities. Good marketing arrangements must be available to sell the crop without delay.

Favourable climate. Cranberries thrive best in moderately cool weather although the temperature must not be so low as to retard blossoming, the development of the berries or the growth of the vines.

Considerable capital. The proper development of a large cranberry bog requires a good deal of capital. However, the cost of maintenance is small and the returns on a good bog proportionately large.

Experienced and competent management. This entails a thorough knowledge in the control of insects and diseases liable to affect the vine and fruit, in the handling of water for irrigation and flooding, in frost forecasting, in the marketing of the crop and in the general supervision of the bog.

BLUEBERRIES

The wild blueberry which flourishes on peat barrens and other acid soils throughout Canada is widely utilized. Not only does it enjoy a large domestic consumption, but sizable quantities are exported each year to the United States. In 1928 exports totalled 3,115,169 lbs., valued at $315,560, and in the fiscal year ending March 31st, 1929 2,476,659 lbs., worth $222,837 were exported.

Both the domestic and export markets for blueberries are capable of great extension. The demand for fresh fruit is growing and the preserved and dried varieties are becoming increasingly popular. It is therefore fortunate that the Canadian output can be easily augmented by the improvement of the wild blueberry bogs and by the introduction of cultivated blueberries on suitable peat lands.

The production of the wild crop could be best increased by the systematic burning of certain areas each year under the supervision of provincial fire rangers. The blueberry fruits on one year old wood, hence it is essential that the growth of new wood be promoted every few years. The year of burning is followed by no crop but during the second and third years heavy crops should result. Where burning is not practical mowing the weeds and old bushes gives beneficial results.

The cultivation of both high and low bush blueberries on peat lands in Canada is also an attractive possibility, owing to the fact that the cultivated varieties usually command a material premium in price over the wild blueberry. The production of cultivated blueberries has attained considerable importance in certain sections of the United States.

HEAT INSULATORS

Peat has been little used, as yet, for heat proofing purposes on this continent, except as a banking material. In the colder countries of Europe, however, it has been utilized fairly extensively.

In Iceland and the more northerly parts of the Scandanavian countries sod cut from the surface layer of peat bogs has been used from olden times for the construction of house walls. This sod consists of a closely felted layer of plant roots impregnated with organic acids which, having considerable preservative qualities, possesses great resistance to rotting.

During recent years, however, particularly in Iceland, the sod walls have been largely supplanted by hollow monolithic walls with the air space filled by powdered peat. It has been found in this type of construction that provision must be made for adding peat dust when settlement occurs and that the outer concrete slab must be waterproofed to keep moisture from the peat. Peat litter and peat mull are also used throughout Europe for insulating the air spaces of hollow brick walls and in the stud spaces of frame buildings.

Although various forms of loose peat are popular for insulation purposes, the major utilization of peat in such countries as Germany, Russia, Sweden and Denmark is in the form of manufactured boards or slabs. One type of peat board widely employed is known as 'Torfoleum'. It is manufactured at Poggenhagen and other strategic points in Germany from fibrous peat. It is chemically treated to render it fire resistant and waterproof and is claimed to be good for at least twenty years service under ordinary conditions. Professor Dyckerhoff, its inventor, found the commercial conductivity to be .29 B.T.U's per hour.

Torfoleum and other European peat boards are used in the insulation of dwellings, industrial plants, cold storage warehouses, refrigerators, refrigerator cars and passenger coaches. Several ships of the Hamburg-American line including the Leviathan are insulated with Torfoleum. This type of board is also extensively used in Russia both for the insulation of dwellings and large buildings.

Considerable interest is now being evidenced in Canada in the possibilities of utilizing suitable domestic bogs for the production of heat insulators.

Realizing that a good deal of experimental work would be required to determine whether or not durable peat insulators such as boards and loose fillers could be successfully manufactured from Canadian peat, also to determine what particular bogs would be most suitable for this purpose, some interested parties brought the matter to the attention of the National Research Council at Ottawa. The Council took the subject under advisement at once and has already carried out some preliminary experiments on the production of peat boards and methods of fireproofing them. From the results obtained to date it is not yet possible to state definitely the commercial possibilities for the utilization of Canadian peat and peat moss as insulating materials. The experimental work is being continued.

REFORESTATION

It is sometimes feasible, by draining and reforesting certain classes of peat bogs, to secure an excellent growth of trees. In North Europe, particularly Finland and Sweden, very productive forest lands have been gained by the draining of peat bogs. In Denmark, reforestation schemes are promoted by a state-aided society under whose direction over 2,000 forest plantations, aggregating 195,000 acres, have been made on peat lands.

Mr. Väinö Auer, in his report on 'Problems of Peat Bog Investigation in Canada', contained in Geological Survey Summary Report, 1927, Part C, states that "the principal uses to which the peat bogs of eastern Canada can be put to are the moss litter industry and afforestation."

At the present rate of depletion of pulp wood reserves, broad reforestation plans would seem to be necessary if Canada is to maintain her supremacy in the production of paper. An investigation regarding the suitability of some of the large, easily accessible bogs of eastern Canada for reforestation purposes would therefore seem to be worthy of consideration.

MISCELLANEOUS

Surgical Dressings.

During the war large numbers of surgical bandages of all kinds were made from sphagnum moss and used in hospitals and first aid stations in several theatres of war. From October 1917 to November 11, 1918, 600,000 peat moss pads were gathered from bogs in the United States. Large quantities of moss were also collected for this purpose in Ireland.

On account of the exceptional absorbent, deodorant and antiseptic qualities of sphagnum moss the surgical pads were found to be an excellent substitute for absorbent cotton.

A similar material, known as peat batting or peat wool, produced in France is widely utilized for bandaging in veterinary work. It is also employed as a filler for mattresses and for various upholstering purposes.

Linoleum Filler.

A Swedish inventor recently claimed to have developed a new method of manufacturing linoleum using powdered peat as a filler instead of cork. Important advantages are advanced for this "Peat Linoleum", including a material reduction in the cost of raw materials and a much shorter process cycle.

Textiles.

For many years efforts have been made in Europe to utilize the strong fibres obtained from certain fibrous varieties of peat for the production of textile yarns.

Blankets for horses and other live stock have been woven from such yarn and in Germany and Sweden a durable yarn has been made from a mixture of peat fibres, shoddy and wool, from which a cloth resembling cheviot was woven.

A yarn of peat fibres mixed with wool has been used in making certain kinds of underwear. A famous French brand of underwear is said to owe its popularity to this mixture, which is claimed to be warmer than pure wool, because of the insulating properties of peat.

Paper and Cardboard

Several attempts have been made both in Europe and the United States to utilize peat fibres in the production of paper and paperboards. While a measure of success attended some of these efforts for a time, the low cost of wood pulp and the difficulties encountered in producing a uniform product eventually forced the abandonment of all such projects.

Sweeping Compounds.

Peat may be used for the production of sweeping compounds. The short-fibre peat which occurs in some well-drained bogs is suitable for use direct, without additional drying.

In the manufacture of one such compound the following proportions of raw materials are:

Short-fibre peat (60 to 70 per cent moisture)	64	lbs.
Neutral mineral oil	8	"
Clean, fine sand	28	"
	100	

The oil is first added to the peat and mixed thoroughly to ensure uniform distribution. The sand is then well mixed with the oil saturated peat.

Porous Brick

Experimental work carried out at Minneapolis indicated that wet or dry peat, either fibrous or mature, could be successfully used as a filling agent for the manufacture of insulating brick.

The mixture of clay and peat was moulded into desired shapes, dried and fired. During the burning process the peat burned out leaving a light porous brick.

Peat Zones In Coal Mines.

Wet peat zones to prevent explosions in coal mines from the excessive accumulation of coal dust have been experimented with in Germany. The zones were produced by hanging curtains made of peat blocks enclosed between wire netting, along the walls. In this manner safety zones were easily established and extended as required.

Owing to the ability of peat to absorb large amounts of water and retain it for long periods it was only found necessary to saturate the curtains once or twice a week to keep the dust below explosion point.

Firelighters.

Air dried peat has been used for the manufacture of small cubes of peat impregnated with inflammable materials known as firelighters. In England the industry has been carried on for several years in the Sutton district near St. Helens, Lancashire, and more recently has been started near Bristol and in the vicinity of Glasgow, Scotland.

In the production of these lighters at one plant the peat blocks are cut by a bandsaw into two-ounce cubes, a ton of peat yielding about 18,000 pieces. The cubes are then dipped in a mixture of crude naphthaline salts and creosote oil and packed for sale in cardboard containers.

Peat waste is sometimes also utilized for the making of firelighters, the loose material being compressed by a machine into cubes which are impregnated in the usual way.

These firelighters are said to be impervious to dampness and do not crumble or soil the hands. They are easily ignited with a match and burn freely with considerable flame for some time.

Other Products.

Peat has also been used or its use has been suggested in the production of a great variety of materials including wax, alcohol, wall boards, structural blocks and bricks, electric insulators, felts, activated carbon, dye stuffs, flower pots, fine fillers and many other products.

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